How To Make Great Sounding Wind-Chimes

James Skipper, East Mississippi Community College

Discussion and Materials:

Wind chimes can be a thing of beauty and enjoyment. They are readily available with prices ranging from a few dollars to over a hundred dollars. The best ones sound great in the store but often times do not chime in gentle breezes. Many are not even assembled correctly to produce their best sounds. (They either are not suspended at their nodes or they are not struck at their anti-nodes.) Why not make your own? It is a good learning project and they may sound better than the ones you buy.

The material needs to be weather resistant. Use thin redwood paneling to suspend light aluminum chimes made of shower curtain rod. Oak or other durable material could be used for heavier tubes. Fishing line or nylon cord works equally well to hang everything from. Golf balls are weather resistant and work well for strikers. Round wood pieces also work well. The tubing is your choice. Anodized aluminum tubing about 3/4 or 1 inch in diameter sounds best. However, that is a little expensive and not locally available. Half inch or three-quarter inch galvanized electrical conduit works pretty well. My choice is 1-inch diameter shower curtain rod. It costs about fifty cents per foot, comes in 5-foot sections and can be purchased from General Supply in Meridian. It is easy to cut with a tubing cutter, easy to drill with a small hand drill, doesn't corrode and is light enough that it moves easily-in gentle breezes.

Procedure for Making Wind Chimes

1. Cut a piece of tubing 50.0 cm long. Measure accurately the length.

2. Measure down 22.4% from the end (11.2-cm) and mark the spot. This is the correct position for the hole. This is the position of a node, a place where the tubing is not vibrating.

3. Measure down to the middle of the tube and mark this spot. This is the position between two nodes, the anti-node. This is where the tube should be struck.

4. Use a nail to make a small indention where the holes are to go.

5. Drill the holes, making sure that they are level. A drill press makes this easy but a hand drill is good enough.

6. A small round file, the kind you sharpen chain saw blades with, is good to smooth the hole with so there are no sharp metal burrs.

7. Suspend the tube with a string and strike lightly with a piece of wood, golf ball or rubber hammer.

8. Determine its pitch. You can use a piano keyboard if you have a good ear to get very close. A computer interface and microphone is the easiest way to find the frequency of a tube. (I use PASCO Science Workshop Model 500 and a student sound sensor.) When you know the pitch of this chime, it is easy to calculate the lengths that are needed to make a "tuned set of chimes."

9. To determine the lengths needed, determine the relationship between length and frequency, a constant (K) as long as you use the same material. To find K, multiply the length of the tube times the square root of its resonance frequency.

10. Decide what notes you want your chimes to play. I use the C7th cord (C, E, G, B flat) for a set of 4 chimes, C9th for 5 (add D). You can experiment on a piano, guitar or other instrument to find the notes that you think sound good together or you can look at commercial chimes that you think sound good and see what notes they play.

11. The chimes need to be at least 30 cm in length to sound good. Consult the chart and find the octave that contains the frequency closest to the frequency of your 50-cm length tube.

12. Calculate the lengths of the tubes you need to produce the notes that you want. To calculate the lengths needed, divide the constant (step 9) by the square root of the frequencies desired. You can calculate the length with any calculator, it just takes repeating the arithmetic for each length and each node. Just divide the K value by the square root of the frequency you want. To find the node, multiply this value by .224.

13. I like using the STATS function of the TI-83 to do this. Press STATS, Edit, then enter the frequencies of the notes you want in column L 1. Move to the top of column L2 and enter the formula, (your numerical value for K divided by the square root of L1). The lengths corresponding to each frequency should be automatically calculated. In column L3, move your cursor to the top of L3 and enter the formula (.224*L2) to calculate the node positions.

14. Measure and cut the lengths for the set of tubes. It is better for the tube to be too long that for it to be too short because you always make it shorter. I suggest that you make them I mm longer than your calculated lengths. Suspend each chime and check its frequency with the computer. You can raise the pitch by filing or grinding off a little from each end of the tube.

15. Use fishing line or nylon cord to suspend the chimes from the wood platform or a metal ring. You may want to do step 15 first. Actually you will have to adjust both, so don't make any permanent knots yet.

16. A small "eye screw" works well to attach the striker to the chime platform. Run the line through the striker (golf ball or piece of wood) and adjust the striker and chimes so that each chime is struck in its center. This will take some adjusting but like any musical instrument, the chimes sound best when everything is adjusted perfectly.

17. Add a small piece of wood (the wind-catcher) to the end of the cord.

18. Suspend the platform with line so that it will hang level.

19. You are finished making the chimes.

20. You will want to hang them in a place where they will be exposed to the wind. I like hanging them from a small limb on a tree so that even gentle breezes cause the chimes to play.

21. Enjoy!

Use a physics textbook to understand the following terms and concepts: Wavelength, frequency, node, anti-node, resonance, standing waves, noise, music, constructive and destructive interference, beats, power and decibels.

Reference: *The Physics Teacher,* April, 1998

Calculations

Example: I find that a tube 48.4 cm long produces a frequency of 512 Hertz. Multiplying the length (48.8 cm) times the square root of the frequency (22.63) equals 1104. This is a constant for that that material. To calculate the length of a tube that should resonate at C, 261.6 Hertz, divide the constant by the square root of 261 and you should get 68.3 cm as the calculated length of the tube. The length should be 68.25cm. Using aluminum shower curtain rod, the following lengths were calculated.

Hertz	Length(cm)	**Frequency**	**Note**
261.6	68.3	261.63*	C
277.2	66.3	277.18	D flat
293.7	64.4	293.66	D
311.1	62.6	311.13	E flat
329.6	60.8	329.63 *	E
349.2	59.1	349.23	F
393.0	55.7	369.99	G flat
370.0	57.4	393.00*	G
415.3	54.2	415.30	A flat
440.0	52.6	440.00	A
466.2	51.1	466.16*	B flat
493.9	49.7	493.88	B

If you wanted notes at a higher pitch, or move up one octave, double the frequencies. If you wanted to move down one octave, you would half the frequencies.